Evolution and the human mind

Modularity, language and meta-cognition

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Published in association with the Hang Seng Centre for Cognitive Studies, University of Sheffield

CAMBRIDGE
UNIVERSITY PRESS

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS
The Edinburgh Building, Cambridge CB2 2RU, UK www.cup.cam.ac.uk
40 West 20th Street, New York, NY 10011-4211, USA www.cup.org
10 Stamford Road, Oakleigh, Melbourne 3166, Australia
Ruiz de Alarcón 13, 28014 Madrid, Spain

First published 2000

Typeface Monotype Times NR 10/12 pt *System* QuarkXpress™ [SE]

A catalogue record for this book is available from the British Library

Library of Congress cataloguing in publication data

Evolution and the human mind: modularity, language and meta-cognition /
edited by Peter Carruthers and Andrew Chamberlain.
p. cm.
Includes bibliographical references and indexes.
ISBN 0 521 78331 3 (hardback) – ISBN 0 521 78908 7 (paperback)
1. Genetic psychology – Congresses. 2. Modularity (Psychology) – Congresses.
3. Metacognition – Congresses. 4. Psycholinguistics – Congresses.
I. Carruthers, Peter, 1952– II. Chamberlain, Andrew, 1954–
BF711.E94 2000 155.7 – dc21 00-021834

ISBN 0 521 78331 3 hardback
ISBN 0 521 78908 7 paperback

Transferred to digital printing 2003

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1 Introduction

Peter Carruthers and Andrew Chamberlain

The extension of Darwin's theory of evolution to human form, function and behaviour has always been controversial. Evolutionary explanations of the human mind, with its apparently unbounded capacities and responsiveness to environmental influences, and of human culture, with its myriad creative diversity and transcendence beyond mere functionality, have been particularly contested. As a result, evolutionary approaches in the social and cognitive sciences have gained ground slowly and haltingly. But insofar as the human body has been moulded and shaped by evolutionary pressures operating in our ancestral past, it seems likely that the biological structures and mechanisms underlying human cognition will also have been selected for; and in this sense, at least, the human mind must have an evolutionary history. What is rather more contentious is whether properties intrinsic to the mind itself were selected for in evolution. In this brief opening chapter we survey the range of stances which can be taken towards this issue, and we outline some recent developments in psychology, archaeology, anthropology, philosophy and the neurosciences which provide the background for the chapters which follow.

1 From modularity to evolutionary psychology

Ever since the cognitive revolution in psychology began, with Chomsky's devastating review (1959) of Skinner's *Verbal Behavior* (1957), the evidence has gradually been mounting in favour of the *modularity* of many mental functions and capacities – that is, in support of the view that cognition is subserved by a number of innately channelled, domain-specific systems whose operations are largely independent of, and inaccessible to, the rest of the mind. Initially the evidence only supported modularism in respect of the so-called 'input and output systems' – the information-rich sensory channels such as vision, audition, taste, touch, pain perception, and the specialised mechanism for acquiring and communicating via language. The *locus classicus* for this early form of 'peripheral systems modularism' was Fodor's *The Modularity of Mind* (1983). But evidence has since been build-

ing up in support of the view that many central systems too – particularly those systems charged with the generation of beliefs from perception or from other beliefs – are broadly modular in structure (Atran, 1990; Baron-Cohen, 1995; Sperber *et al.*, 1995). And while Fodor's initial characterisation of the nature of modules (as innate, fast, domain-specific, and informationally encapsulated, with proprietary inputs and shallow outputs) was highly restrictive, other theorists have since liberalised the notion (for example, dropping the requirements of shallowness and strict encapsulation) in such a way that some central conceptual systems might plausibly be thought to be modular in nature (Smith and Tsimpli, 1995; Sperber, 1996; see also Segal, 1996, for a useful review of different notions of modularity).

While modularism has generally been associated with nativism, or anti-empiricism, not every modularist has taken an evolutionary perspective. Indeed, the two most famous proponents of modularism – Chomsky and Fodor – have purposefully avoided all evolutionary theorising themselves, while often being scathing of the evolutionary explanations of others, and have been inclined to see the appearance of modules as a mere by-product of the expansion of the hominid neocortex (Chomsky, 1988; Fodor, 1998). Few would now share their position, and the contributors to this volume are united in rejecting it. For as Pinker and Bloom (1990) decisively point out, evolution by natural selection is the only form of non-cultural explanation we have of the development of organised goal-directed complexity, such as the mammalian eye manifestly has, and such as would be possessed by any of the postulated cognitive modules (see also Pinker, 1994).

It has been objected that evolutionary explanations of already-known structures come cheap, amounting to little more than just-so stories. This may well be so, if those explanations are constructed a priori, without regard to other relevant evidence. But in fact a good explanation needs to be constrained by what is known, or can reasonably be inferred, about the environments in which the structures first appeared, and the selective pressures operating within them. Here the would-be evolutionary explainer needs to look to the evidence provided by archaeology, palaeontology and comparative biology. The task of providing evolutionary explanations of cognitive structures, in particular, is inherently interdisciplinary, requiring input from each of these disciplines, as well as from cognitive psychology and neuroscience.

Not only are evolutionary explanations of cognitive structures quite legitimate (and the good ones not especially cheap), but also in our view evolutionary thinking can also prove fruitful for psychology itself. For by thinking hard about the adaptive problems which our ancestors probably faced, we can generate novel, testable hypotheses concerning the cognitive

adaptations which we may possess. Thus Cosmides and Tooby (1992) argue, for example, that since our hominid ancestors very probably engaged in reciprocal social exchanges of various sorts, which would have been crucial both for reproduction and for survival, they are likely therefore to have possessed an evolved adaptive mechanism for rationally negotiating such exchanges – for calculating the cost-benefit structure of an exchange, for keeping track of who owes what to whom, and for detecting cheaters and free-riders. Cosmides and Tooby then set out to test this hypothesis by seeing whether people reason better in tasks which have a cost-benefit structure than they do in structurally identical tasks which lack such a structure – with dramatically confirmed results.

The intellectual movement now known as 'evolutionary psychology' goes even further than this again, in postulating that the mind contains a whole suite of modular adaptations (Barkow *et al.*, 1992; Pinker, 1997b). This is the *Swiss-army knife model* of cognition (to be contrasted with the empiricist model of the mind as a large general-purpose computer). According to this model, the mind consists (more or less exclusively) of a whole host of modular adaptations, selected for at different points in our evolutionary ancestry, but maintained to the present day either through inertia or through continued stabilising selection. This view is said to have biological plausibility on its side, since in general natural selection is claimed to operate by bolting-on specialist adaptations to existing structures in response to specific adaptive pressures (Cosmides and Tooby, 1987). Not all the contributors to the present volume endorse this model, by any means. But it undoubtedly provides a useful foil to both empiricism (or the big general-purpose computer model), on the one hand, and to the anti-evolutionary modularism of Fodor (1983, 1998) on the other.

An important distinction can be made between contemporary evolutionary psychology and the earlier intellectual movement known as 'sociobiology' (Alexander, 1974; Wilson, 1975, 1978). Socio-biology and its modern linear descendant, behavioural ecology, emphasise the adaptive function of behaviour, and view behavioural variability as demonstrating that organisms (as individuals or as typical members of a species) possess a flexible repertoire of optimised responses to varying environmental conditions (Irons, 1979). Evolutionary psychology, by way of contrast, eschews arguments about the functionality of behaviour *per se*, and focuses instead on cognitive *mechanisms* – specifically systems for generating beliefs and goals. What behaviours – if any – then result may be quite variable, since they will depend upon what other beliefs and desires the agents in question possess. Although it is likely that cognitive mechanisms will only have been selected for in so far as they reliably generate behaviour that influences fitness (Borgerhoff Mulder, 1991), evolutionary psychology places this

selective environment in the distant past, thus deflecting the naive accusation of 'environmental determinism' that has frequently been levelled at socio-biology. On one way of picturing the matter, the evolved mechanisms postulated by evolutionary psychologists generate many of our beliefs and desires for us; what we then *do* in the light of our beliefs and desires will depend upon the operations of our practical reason, social adeptness and individual preferences and inclinations – and these can be as non-deterministic as you please.

2 Cognitive archaeology and evolutionary anthropology

Much of the research effort in evolutionary psychology has focused on features of the mind that are more or less unique to humans (e.g. language, consciousness of self and others, aesthetic preferences and psychopathology, to name but four examples). Rudimentary precursors of these cognitive domains and faculties exist in great apes and some other primates, but in its salient properties the human mind is really rather different from the minds of non-human animals. This causes some problems for an evolutionary theory of the mind: the uniqueness of the human mind implies that the comparative method – in this case, comparing human mental faculties with those of non-human animals – may not be a particularly fruitful source of insight, and correspondingly a premium is placed on any evidence which can be obtained from the palaeontological and archaeological records that relate more directly to human evolutionary history.

If fossilised hominid brains could be found that preserved details of neuronal structures, or if there was durable and unequivocal material evidence for hominid beliefs and intentions, then palaeoneurology and palaeolithic archaeology would be well placed to document the evolutionary history of the mind. But unfortunately the quality of the fossil and archaeological evidence falls well short of this ideal. From the study of hominid cranial endocasts – replicas of brains derived from the negative relief of the internal surface of the skull – the amount and rate of brain size increase in human evolution can be determined (this provides, *inter alia*, the empirical evidence for Dunbar's hypothesis of increased group size in early *Homo*; Dunbar, 1993). But the evidence for changes in neural structure and cortical organisation is much less clear, as exemplified by the debate between Holloway (1983a) and Falk (1985, 1989) on the size of the visual cortex in *Australopithecus*, and the uncertainty over the identification of language centres on the endocasts of early *Homo* (Holloway, 1983b; Tobias, 1987). Given that important domains such as consciousness are now thought to involve a widely distributed neural substrate (Tononi and Edelman, 1998), there is likely to be little prospect of inferring the details of

hominid cognition from the shapes of the bulges and indentations observable on hominid brain endocasts.

Archaeology's intellectual roots are very firmly anchored in the social sciences, and despite well-publicised appeals for the establishment of a research programme in cognitive archaeology (e.g. Renfrew, 1982) many archaeologists remain unwilling to relinquish the primacy of social factors in their explanations of past material culture and human subsistence behaviour. Social archaeologists (such as Hodder) see individual decision making and agency as inextricably enmeshed in social structures and sociocultural relations that are historically contingent and culturally specific:

> There are few if any aspects of cognition which do not partly depend on social rules and goals – on the social context. Thus an adequate approach to cognition must also consider social meanings, social structures, relations of power and domination. (Hodder, 1993, 256)

Others (such as Clark) have criticised the aims of cognitive archaeology on the operational grounds that individuals and their actions are not traceable in the archaeological record:

> I submit that, since the actions of individuals are forever likely to be beyond the resolution of the Palaeolithic archaeological record, we are compelled to adopt the group as the analytical unit if we ever hope to submit our ideas about the human past to any kind of an empirical test. (Clark, 1992, 107)

This reluctance to concede that individuals can be extracted from their social context, together with a continuing uncritical reliance on group selection as a mechanism for explaining past cultural change (cf. Mithen, 1993), has contributed to the tardy and equivocal reception of cognitive approaches in archaeology, and it is only in the last decade that serious and sustained attempts have been made to integrate archaeological theory and data into accounts of human cognitive evolution (Donald, 1991; Renfrew and Zubrow, 1994; Mithen, 1996b).

While it is undeniable that palaeopsychology will continue to be a difficult and challenging field of study, particular categories of archaeological evidence have the potential to illuminate aspects of human cognitive evolution. Wynn (this volume, chapter 6) points out that a more or less continuous sequence of evolutionary development in geometric and technological competence can be reconstructed from the archaeological record of stone tool manufacture. Decisions that were executed in the procurement of raw materials and in the *chaîne opératoire* – or sequence of flake removals whereby an unmodified core is converted into a finished artefact – can also reveal the extent to which the behaviour involved in stone tool manufacture was opportunistic or purposive (Mithen, this volume, chapter 9). The caveats, of course, are numerous: only a minimum

level of competence may be revealed in stone artefacts, and archaeologists are aware that there is no correlation between technological sophistication and cognitive ability among the great diversity of ethnographically documented modern human cultures.

Symbols are central to human thought and language, and the emergence of material evidence for symbolic behaviour at the beginning of the Upper Palaeolithic, some 35,000 years ago, has been linked to the evolution of a fully modern cognitive capacity (Lindly and Clark, 1990). Together with the appearance of representational and decorative art, the introduction of burial rituals and the accelerated diversification of technology, this complex of innovations constitutes the 'cultural explosion' at the Middle–Upper Palaeolithic transition. Many archaeologists believe that the emergence of fully-modern language correlates with the Upper Palaeolithic cultural revolution, but this proposal is contradicted by palaeontological arguments which place the origins of language considerably earlier in human evolution.

The concept of an Upper Palaeolithic 'cultural explosion' has itself been challenged on the grounds that it is only in western Europe that a clear-cut contrast is apparent between the behaviour of archaic Neanderthals and modern Cro-Magnon humans, and even in Europe some of the late Neanderthals are associated with an Upper Palaeolithic style of technology (Hublin *et al.*, 1996). Elsewhere in the world patterns of modern human behaviour seem to emerge either contemporaneously or earlier than in Europe (Bahn, 1991), and in a more gradual fashion (Harrold, 1992), indicating that the abrupt behavioural transition in Europe at the beginning of the Upper Palaeolithic may have been atypical and may not necessarily have coincided with a sudden advance in cognitive capacity.

Anthropology, too, is rooted in the social sciences, and shares the same background conception of the mind as socially and linguistically determined. Indeed, anthropologists have traditionally delighted in attesting to the almost-infinite diversity of human belief-systems, social practices and behaviours, which seemed to reinforce their picture of the mind as a social–linguistic construct. But in recent decades a number of anthropologists have advocated Darwinian explanations of human culture and thought, with their approaches falling broadly into two movements. The first, which has been advanced under the banner of evolutionary culture theory (Boyd and Richerson, 1985; Durham, 1991, 1992; see O'Brien, 1996, for applications to archaeology) seeks to explain the observed variation in human cultural systems through an explicit model of transmission with selective retention, in a direct analogy with the role of natural selection in biological evolution. Although the approach is clearly distinguished from socio-biology in not explicitly and directly linking human behaviour to

genetic fitness, evolutionary culture theory remains problematic on several counts, including disagreements about the nature of the cultural elements transmitted, and uncertainties over the roles of purposeful versus random selection and the relative contributions of selection acting on groups versus the effects of selective pressures on individuals.

The second – and in our view more successful – approach abandons direct evolutionary explanations of specific cultural repertoires and behaviours, and seeks instead to discover the cognitive universals which underpin the diversity of human thought and action (e.g. Atran, 1990, 1998; Brown, 1991; Boyer, 1994b; Sperber, 1996). By combining psychological and anthropological data, and through broad cross-cultural comparisons incorporating studies of both modern and traditional cultures, the structural elements of a range of different domains of naive- or folk-knowledge have been elucidated. Insofar as these cognitive universals must have been inherited from our species' common ancestor, they are likely to have evolved through natural (as opposed to cultural) selection and are presumably components of an adaptive cognitive response to features of Pleistocene environments and Palaeolithic social organisation.

3 Developments in philosophy

The recent developments in philosophy which are most relevant to the current project are of a rather different sort from those in psychology, archaeology and anthropology – *domain-general* as opposed to *domain-specific*, as you might say. It is true that the thought of some philosophers has taken a directly evolutionary turn, specifically as regards the proper explication of intentional content or meaning, where there is now a flourishing tradition of *teleosemantics* (Millikan, 1984, 1989; Papineau, 1987, 1993). But of more relevance to the topics discussed in the current volume is an increasing willingness on the part of some philosophers to engage directly in interdisciplinary work, across a variety of fields. While some philosophers continue to guard jealously what they consider to be the proprietary domain of philosophy – namely conceptual analysis and a priori argument – many others have thought that philosophers can also address substantive questions, in science and elsewhere. In part this trend may be influenced by Quine (1951), who denies that there is any sharp distinction between philosophy and science – rather, there is simply the web of our beliefs, within which certain assumptions may be more or less deeply embedded. But more importantly, it may stem from a realisation that there is nothing to *prevent* philosophers from engaging in substantive enquiries, and that in some respects they are especially well placed to contribute to debates of an interdisciplinary sort.

Philosophers have traditionally concerned themselves with the *big* questions, or with the questions of utmost generality – for example, 'Must every event have a cause?', 'Must the world have a beginning?', 'What distinguishes mind from matter?', 'What is life?', and so on. (Indeed, when seen from a historical perspective, the twentieth-century concentration on questions of a priori conceptual analysis seems like a statistical blip.) Many of these questions now properly fall within the domain of some science or other, of course – thus the question, 'What is life?' is now asked (and answered successfully) within scientific biology. But there remains plenty of scope for philosophers to concern themselves with questions of the same highly general sort, especially ones which cross the boundaries of scientific investigation. Moreover, the traditional philosophical skills of distinguishing carefully between different questions, or different variants of a theory, and of teasing out the implications of theories proposed in a given area, or uncovering the implicit assumptions of the theory proposers, are just what interdisciplinary investigation requires. (We do not claim that philosophy is *uniquely* well placed to contribute to interdisciplinary debates, of course, only that it is no accident that contributions made by philosophers can often prove fruitful.)

4 A guide through the volume

All of these developments – the build-up of evidence for modularity in psychology and neuroscience; an increasing willingness to seek evolutionary explanations of cognitive abilities; the advent of evolutionary psychology as an intellectual movement; an increasing willingness amongst archaeologists to draw inferences about hominid cognition from their data; the beginning of a search for cognitive universals by anthropologists; and a willingness amongst philosophers to engage in interdisciplinary investigation of a substantive sort – serve to set the background for the project of this book. In this section we shall briskly guide the reader through the chapters which follow, drawing attention to a variety of recurring themes and cross-connections.

The first five substantive chapters of the book (2 to 6) focus in different ways on the thesis of mental modularity and its applications. Samuels (chapter 2) is concerned to distinguish two different versions of modularity thesis, and to defend both against anti-nativist attacks. He distinguishes *computational* from *intentional* modularity. According to the first, the mind contains many innately-channelled discrete domain-specific computational mechanisms (this is the 'Swiss-army knife model'); according to the second (which Samuels calls the 'Chomskian model' of cognition) the mind contains innate domain-specific bodies of specialised knowledge which are

accessed and processed centrally by general-purpose, non-modular, cognitive mechanisms. Although almost all evolutionary psychologists commit themselves to the computational variety, Samuels argues that the evidence does not currently favour it over the Chomskian model. He then takes up the challenge to the nativistic element in either form of modularity mounted by Elman *et al.* (1996), showing that their main arguments make unwarranted assumptions.

One major tenet of evolutionary psychology is that mental modules are adaptations, each of which evolved in response to a particular problem posed by the environment of evolutionary adaptation. In contrast to domain-general accounts of cognitive ability, the modular model does not posit a common underlying genetic basis to abilities in different domains. Hughes and Plomin (chapter 3) present dramatic results from a study of theory of mind and verbal ability in pairs of normal three-year-old twins. Their data show, *inter alia*, that most of the variance in theory-of-mind abilities at age three is genetic, and that most of the genes in question are independent of genetic variance in verbal IQ, supporting the case for an independent origin for these two modules.

The next two chapters (4 and 5) explore the implications of evolutionary psychology and mental modularity for other disciplines, hence providing a sort of back-handed defence by demonstrating the *fruitfulness* of the approach. While much of the support for the modularity of mind stems from studies of cognitive dysfunction in individuals who have been diagnosed as suffering from mental disorders, the current standard for the diagnostic classification of mental disorders is structured on pre-evolutionary principles, as Murphy and Stich point out (chapter 4). Murphy and Stich show how a computational systems approach to modular structure permits mental disorders to be divided into distinct categories, according to whether the deficits are module-internal, or affecting input to other normally-functioning modules, or indeed whether a module is functioning correctly but the current environment has changed from the ancestral one in which the module's function was optimised.

Boyer (chapter 5) tackles the thorny issue of the appearance and dissemination of religious concepts. Although there are plenty of adaptive explanations for the existence of religious ideologies in general, the structure and content of religious beliefs are traditionally regarded as being unbounded and idiosyncratic. Boyer demonstrates that religious concepts are strongly constrained by the structure and logic of intuitive ontology, where this ontology is delivered by innately-channelled modular systems for folk-psychology, folk-physics, naive-biology and the domain of artefacts. He shows how ideas which violate the principles of some of these intuitive domains (such as an artefact which listens to prayers) but which

nevertheless allow us to access the rich inferential principles of the underlying knowledge base, are much more readily remembered. It is then easy to see that this would give rise to cross-cultural regularities in the kinds of concepts which are culturally stable and easily propagated, of just the sort that anthropologists observe.

Wynn (chapter 6) – like Papineau (chapter 8) – is concerned to defend a form of non-domain-specific, or general-process, cognition in face of a threatened hegemony of domain-specific modules (the 'Swiss-army knife model' taken to extremes). He uses the property of symmetry in stone tool artefacts as an index of the evolving perceptual and cognitive abilities of pre-modern species of hominid. The symmetry manifest in the artefacts increases in regularity and complexity over time, with essentially modern spatial abilities appearing by 300,000 years ago. Wynn argues that the sophisticated symmetries of these stone tool artefacts demonstrate the presence in these hominids of a central system – or some sort of general processor – which deploys and wields a modular visuo-spatial capacity, rather than a visuo-spatial system which is wholly domain specific.

The remaining essays in the book are all concerned, in one way or another and to varying degrees, with the questions of the evolution of language and of 'theory of mind' (or meta-cognition); and with the questions of the contributions made by these presumably modular faculties to the evolution of other cognitive capacities, and of their involvement in them. Origgi and Sperber (chapter 7) address head-on the question of the evolutionary origins of language. They use some of the conceptual framework provided by Millikan (1984) – in particular her distinction between *direct* and *derived* proper functions – to articulate a certain view of the relations between biological and cultural evolution of language. But they are at pains to dissociate themselves from her 'code conception' of language meaning. In the sort of post-Gricean, relevance-theoretic approach which Origgi and Sperber defend, the question of the evolution of language becomes intimately connected with the evolution of capacities for higher-order thought.

The next three chapters (8 to 10) address the evolution of the human capacity for rational and/or imaginative thought. Papineau (chapter 8) is concerned to explain the evolution of epistemic rationality. He aims to show how knowledge and the systematic pursuit of knowledge (of the sort undertaken by science) are possible, in light of the psychological evidence of widespread epistemic irrationality. There are two main elements in his account: the taking of *truth* as a goal (with reliable belief-formation as the means), and the use of means-ends reasoning in pursuit of that goal. The first is made possible by hominid theory-of-mind capacities, which provide us with concepts of truth and falsehood (perhaps supplemented by an

innate desire for knowledge). The second is said to originate (perhaps) from an evolved, non-modular, capacity for forward planning.

Mithen (chapter 9) discusses the puzzle of the 'cultural explosion' which took place more or less simultaneously amongst humans dispersed around the globe between 60,000 and 30,000 years ago. The puzzle arises because it is now believed that fully modern humans, with a capacity for language, had existed from much earlier – probably from 120,000 years ago, and at least from 100,000 years ago; and that humans then immediately began to disperse and colonise different global regions. Mithen argues that what might have played the main role in the later explosion of creativity and cultural innovation were accretions of material culture, which could serve to externalise certain mental operations and mental powers, somewhat as we use pencil-and-paper calculations and written records today.

Morton (chapter 10) explores how strategic thinking can emerge from competitive and/or co-operative interactions between intelligent interactors. He uses a variety of game-theoretic models and arguments to examine the conditions under which strategic thinking would emerge in evolution, and – like Dunbar (chapter 11) – he draws implications concerning expected group size amongst apes and hominids. Morton argues that different modal sizes of human groups are adaptive for solving different kinds of strategic problem.

Dunbar (chapter 11) examines the anthropological evidence bearing on the origins and adaptive purpose of human theory of mind. In previous work he has established a correlation between brain size and normal group size in monkeys and apes (including human beings), arguing that larger group sizes need to be supported by increasingly sophisticated theory-of-mind abilities (e.g. Dunbar, 1993). In the present chapter he takes up the question of *direction of causality* – did theory of mind develop because of evolutionary pressure towards larger group sizes? Or was there some adaptive pressure for increased theory-of-mind abilities which facilitated larger group sizes as a by-product? He defends the former alternative, and tentatively puts forward the hypothesis that the pressure towards increased group size in hominids was the need to defend crucial resources such as water holes.

In the final two chapters (12 and 13) Carruthers and Hopkins take an evolutionary perspective on the nature of human consciousness. Carruthers (chapter 12) reviews alternative explanations of subjective – or 'phenomenal' – consciousness, and presents the case for this emerging as a by-product of the emergence of the theory-of-mind module. More specifically, he uses evolutionary considerations to adjudicate between four different forms of 'higher-order' theory of phenomenal-consciousness, according to all of which it is the mind's capacity to represent its own states

and operations which gives rise to phenomenally conscious states. The theories in question are: higher-order experience, or 'inner sense' models; actualist higher-order thought theory; dispositionalist higher-order thought theory; and higher-order linguistic description theory. The third of these is argued to be significantly superior to any of the others.

Hopkins (chapter 13) pursues a similar line of argument in showing that introspection does not provide direct (i.e. non-representational) perceptual access to states and processes of the mind. Rather, evolution has led to the internal states of the mind being represented metaphorically, using analogous reasoning based on mechanisms used to attribute internal causes when making sense of events in the physical world. Hopkins shows how the metaphor of the mind as 'internal' gives rise to much that we find most paradoxical about the relations between mind and body.

Conclusion

These are heady times for the understanding of the human mind. Much excellent and innovative work is being done within the particular disciplines of anthropology, archaeology, cognitive neuroscience, cognitive psychology, evolutionary psychology, linguistics, philosophy and primatology. But we believe that it is important, now, that there should be an increased degree of cross-talk between them, of the sort partially represented in this volume. And one crucial peg on which such talk needs to be hung is the evolution of human cognitive mechanisms and faculties. The essays in this book contribute to and advance many specific debates. But the main message is implicit (hereby made explicit): it is that the understanding of the human mind increasingly needs interdisciplinary awareness and collaboration.

The authors would like to thank all those who participated in the 'Evolution and the human mind' Hang Seng Centre workshops and conference, for increasing our understanding of these issues, and also Robin Dunbar for his comments on an earlier draft.